S-TEC 3100
Digital Flight Control System
Digital and Analog Pilot Guide
### Revision Record

Retain this record in front of guide.

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Section 1 Overview

1.1. Document Organization

Section 1 Overview
Section 2 Pre-Flight Procedures
Section 3 In-Flight Procedures
Section 4 EFIS Integration Options
Section 5 Emergency Procedures
Section 6 Operating Parameters
Section 7 Glossary

1.2. Purpose

This pilot guide provides pre-flight and in-flight operating procedures for the S-TEC 3100 autopilot (AP) for both digital and analog interfaced systems.

NOTE:

This pilot guide must be carried in the aircraft (A/C) and available to the pilot at all times. It can only be used in conjunction with the Federal Aviation Administration (FAA) approved Aircraft Flight Manual (AFM) or Aircraft Flight Manual Supplement (AFMS). Refer to the applicable AFM or AFMS for A/C specific information, such as unique ground tests, limitations, and emergency procedures.

The S-TEC 3100 is designed to assist pilots with cockpit workload management. The ability of the AP to provide optimum assistance and performance is directly proportional to the pilot’s knowledge of its operating procedures. Therefore, it is highly recommended that the pilot develop a thorough understanding of the AP, its modes, and operating procedures in visual meteorological conditions (VMC) prior to using it under instrument flight rules (IFR).

1.3. General Control Theory

The S-TEC 3100 is capable of being a two- or three-axis attitude-based digital flight control system. It is comprised of a computer/programmer, which performs input/output processing and control laws, with an integrated bezel/display for mode selection and display, including trim annunciations.
S-TEC servos are coupled to the control system. The roll servo is coupled to the ailerons; the pitch servo is coupled to the elevator; the trim servo is coupled to the elevator trim; and the optional yaw servo is coupled to the rudder.

The AP senses roll attitude, roll rate, heading error, and course deviation to control the roll servo.

The AP senses pitch attitude, pitch rate, pressure altitude, indicated airspeed (IAS), vertical speed (VS), vertical acceleration, and glideslope deviation to control the pitch servo.

With the optional yaw control, the AP senses yaw rate and acceleration to control the yaw servo.

The AP senses an out of trim condition whenever the trim sensor in the pitch servo is activated. In response to this, the AP drives the trim servo in the proper direction until the A/C is in trim.

The AP also includes an altitude pre-select function, if enabled.

1.4. Analog Limitations

The S-TEC 3100 relies on digital air data information for advanced functions such as altitude pre-select. For analog configurations altitude hold is available, but the ALT target is not selectable.

1.5. Optional Yaw Damper

Some aircraft configurations will not have a yaw damper system installed. In these cases, the yaw damper button is blank and the YD LED does not illuminate under any circumstances.

![Figure 1-1: S-TEC 3100 Without Optional Yaw Damper](image-url)
1.6. Principal Modes of Operation

1.6.1. Roll Axis Control

**Autopilot (AP) Mode:** Engages roll servo

**Flight Director (FD) Mode:** Laterally drives steering command bars

**Roll Attitude (ROLL) Mode:** Holds roll attitude

**Heading (HDG) Mode:** Turns onto a selected heading and holds it

**Navigation (NAV) Mode:** Intercepts and tracks a VOR course

**Approach (APR) Mode:** Intercepts and tracks a LOC front course or GPS approach inbound

**Reverse (REV) Mode:** Intercepts and tracks a LOC back course (BC) inbound or tracks a LOC front course outbound

**Control Wheel Steering (CWS) Mode:** Captures and holds new roll attitude, pitch attitude, indicated airspeed, vertical speed, or altitude

**GPS Steering (GPSS) Mode:** Laterally steers along a flight plan course defined by GPS/FMS

**GPS Lateral Navigation (GPSL) Mode:** Laterally steers along an approach course defined by GPS/FMS approach

**Level (LVL) Mode:** Returns A/C to wings level attitude from any condition

**Half Bank (HB) Mode:** Reduces commands in HDG and GPS/FMS steering by half

**Go-Around (GA) Mode:** Disengages AP and/or engages FD in ROLL wings-level mode

1.6.2. Pitch Axis Control

**Autopilot (AP) Mode:** Engages pitch servo

**Flight Director (FD) Mode:** Vertically drives steering command bars

**Pitch Attitude (PITCH) Mode:** Holds pitch attitude

**Indicated Airspeed (IAS) Mode:** Holds indicated airspeed

**Vertical Speed (VS) Mode:** Holds vertical speed

**Altitude Hold (ALT HOLD) Mode:** Holds altitude
Glideslope (GS) Mode: Intercepts and tracks glideslope

GPS Vertical Navigation (GPSV) Mode: Vertically steers along a glidepath defined by a GPS/FMS approach

Level (LVL) Mode: Returns A/C to level flight with a vertical speed of “0” from any condition

Go-Around Mode (GA) Mode: Disengages AP and/or engages FD in pitch hold mode with a preset nose-up command

Automatic Trim Mode: Automatically drives pitch trim servo.

1.6.3. Yaw Axis Control

Yaw Damper (YD) Mode: Dampens excessive adverse yaw and coordinates turns (if installed)

1.7. Block Diagram

Figure 1-2: Block Diagram (With Optional Yaw Damper)
1.8. Display Legend

1) Autopilot (AP) Mode button
2) Flight Director (FD) Mode button
3) Yaw Damper (YD) Mode button (Optional) - (See Figure 1-1)
4) Heading (HDG) Mode button
5) Navigation (NAV) Mode button
6) Approach (APR) Mode button
7) Level (LVL) Mode button
8) Ambient light sensor
9) Indicated Airspeed (IAS) Mode button
10) Vertical Speed (VS) Mode button
11) Altitude Hold (ALT HOLD) Mode button
12) Menu (MNU) Mode button
13) Altitude Selector (SELECT) knobs
14) Up/Down (UP/DN) Modifier switch
15) Altitude Selector/Alerter annunciation
16) Active Pitch Mode annunciation
17) Armed Pitch Mode annunciation
18) Active Roll Mode annunciation
19) Armed Roll Mode annunciation
20) Light Emitting Diodes (LEDs)
Section 2 Pre-Flight Procedures

2.1. Power-Up Test

Perform the following actions during power-up.

1) Set battery master switch to ON position.
2) Set avionics master switch to ON position.
3) Set AP master switch to ON position.
4) Set trim master to ON position.

**NOTE:**

For proper manual electric trim function, both the AP master switch and trim master switch must be on during the autopilot self-test.

The following occur in sequence:

- **Self Test In Progress** appears during AP self-test.
- **ADAHRS INITIALIZING** appears during initial alignment.
- **AP READY** indicates AP is ready for operation.

**NOTE:**

No annunciation in the AP/YD status nor ROLL and PITCH blocks indicates AP READY.

If initial alignment is not valid after configured start-up time or data becomes invalid following the alignment, **AP FAIL** appears.

2.2. Pre-Flight Checks

Perform the following actions prior to takeoff with engine running. See Section 4 for EFIS integration options.

1) Move A/C control left and right to sense freedom of movement about roll axis.
2) Move A/C control forward and aft to sense freedom of movement about pitch axis.

3) If yaw damper option is installed, actuate A/C rudder pedals alternately in succession to sense freedom of movement about yaw axis.

4) Press \textbf{AP} to engage ROLL, PITCH, FD, and YD modes. AP, FD, and YD LEDs, while ROLL and PITCH appear on AP.

\textbf{NOTE:}

If the yaw damper option is not installed, the YD LED does not illuminate in step 4.

5) Move A/C control left and right. Reduced freedom of movement indicates roll servo is engaged. Verify roll servo can be overridden.

6) Move A/C control forward and aft. Reduced freedom of movement indicates pitch servo is engaged. Verify pitch servo can be overridden.

7) If yaw damper option is installed, actuate A/C rudder pedals alternately in succession. Reduced freedom of movement indicates yaw servo is engaged. Verify yaw servo can be overridden.

\textbf{CAUTION:}

\textbf{If any servo in any axis cannot be overridden or fails to disengage during the pre-flight checks, the aircraft should not be flown and the autopilot should be inspected by an authorized service facility.}

8) Set heading bug under lubber line.

9) Press \textbf{HDG} to engage HDG mode. HDG replaces ROLL on AP.

10) Turn heading bug to left of lubber line. A/C control turns to the left.

11) Turn heading bug to right of lubber line. A/C control turns to the right.

12) Set heading bug under lubber line. A/C control stops.
13) Press **IAS** to engage IAS mode. **IAS** replaces **PITCH** on AP. Number indicates lowest airspeed configured for A/C in kts.

14) Press/Hold **UP**. Airspeed indication increases on AP. (For EFIS integration, see § 4.1.)

15) Press/Hold **DN**. Airspeed indication decreases on AP display. (For EFIS integration, see § 4.1.)

16) Press **VS** to engage VS mode. **VS** replaces **IAS** on AP. Number indicates current VS in feet per minute (fpm).

17) Press/Hold **UP** until a commanded VS of **500** (500 fpm climbing) is reached. A/C control moves aft – pilot may have to assist a heavy yoke. (For EFIS integration, see § 4.1.)

18) Press/Hold **DN** until a commanded VS of **500** (500 fpm descending) is reached. A/C control moves forward. (For EFIS integration, see § 4.1.)

19) Press **ALT** to engage ALT mode. **ALT HOLD** replaces **VS** on AP, and VS indication is extinguished.

20) Press/Hold CWS switch to engage CWS mode. **CWS** flashes on AP, while periodic audible alert tone sounds.

21) Move A/C control left and right. Increased freedom of movement indicates roll servo is disengaged.

22) Move A/C control forward and aft. Increased freedom of movement indicates pitch servo is disengaged.

23) Release CWS switch to disengage CWS mode and resume AP control. **CWS** is extinguished on AP.

24) Move A/C control left and right. Reduced freedom of movement indicates roll servo is engaged.
25) Move A/C control forward and aft. Reduced freedom of movement indicates pitch servo is engaged.

26) Verify trim master switch is set to ON position.

**NOTE:**

Reference the AFMS for the particular model as some functionality of automatic trim may differ.

27) Move A/C controls aft to apply force to the pitch servo and simulate out-of-trim condition.

After 3 seconds, pitch trim annunciation (TRIM ↓) appears on AP. Trim wheel runs to counter.

After 8 seconds, TRIM ↓ flashes and audible alert, “Trim in Motion,” sounds repeatedly.

28) Move A/C controls forward to apply force to the pitch servo and simulate out-of-trim condition.

After 3 seconds, pitch trim annunciation (TRIM ↑) appears on AP. Trim wheel runs to counter.

After 8 seconds, TRIM ↑ flashes and audible alert, “Trim in Motion,” sounds repeatedly.

29) Set trim master switch to OFF position.

30) Repeat steps 27 and 28. The results are identical with the exception that trim does not drive the corresponding axis, and “Check Pitch Trim” sounds repeatedly to alert the pilot that trim power is off or in a failed condition.

31) Press and hold AP DISC/TRIM INTR switch. AP READY appears on AP and audible alert sounds, while all other annunciations and all LEDs are extinguished. “Autopilot Disconnect” sounds once.
32) Move A/C control left and right. Increased freedom of movement indicates roll servo is disengaged.

33) Move A/C control forward and aft. Increased freedom of movement indicates pitch servo is disengaged.

34) If yaw damper option is installed, actuate A/C rudder pedals alternately in succession. Increased freedom of movement indicates yaw servo is disengaged.

35) Set trim master switch to ON position.

36) Press both forward and aft on each segment of manual electric trim switch, independently of the other. In each case, A/C elevator trim wheel does not run.

37) Press/Hold aft on both segments of manual electric trim switch. TRIM flashes on AP, and A/C elevator trim wheel runs nose up.


40) Release manual electric trim switch. TRIM is extinguished on AP, and A/C elevator trim wheel stops.

41) Press/Hold forward on both segments of manual electric trim switch. TRIM flashes on AP, and A/C elevator trim wheel runs nose down.


44) Release manual electric trim switch. TRIM is extinguished on AP display, and A/C elevator trim wheel stops.

45) Press GA switch. FD LED illuminates (AP not engaged), while ROLL and PITCH appear on AP display.

46) Trim A/C for takeoff.
Section 3 In-Flight Procedures

3.1. Normal Operating Procedures

3.1.1. Roll Attitude (ROLL) Mode

From any active condition shown in Table 3-1, the corresponding action engages roll attitude mode. **ROLL** appears. The AP holds the A/C at its current (captured) roll attitude.

<table>
<thead>
<tr>
<th>Table 3-1: Roll Attitude (ROLL) Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Active Condition</strong></td>
</tr>
<tr>
<td>AP READY</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>HDG mode engaged</td>
</tr>
<tr>
<td>NAV mode engaged</td>
</tr>
<tr>
<td>APR mode engaged</td>
</tr>
<tr>
<td>Any mode engaged</td>
</tr>
</tbody>
</table>

![Figure 3-1: Roll Attitude (ROLL) Mode](image)

3.1.2. Heading (HDG) Mode

Set the heading bug to desired heading on the compass card. From any active condition shown in Table 3-2, the corresponding action engages heading mode. **HDG** appears. The AP turns the A/C onto the selected heading and holds it. A new heading can be selected thereafter by setting the heading bug to it.
Table 3-2: Heading (HDG) Mode

<table>
<thead>
<tr>
<th>Active Condition</th>
<th>Action</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roll mode engaged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NAV mode engaged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>APR mode engaged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>REV mode engaged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HDG mode engaged</td>
<td>HDG pressed</td>
<td>HDG mode engaged</td>
</tr>
</tbody>
</table>

Figure 3-2: Heading (HDG) Mode

3.1.3. Navigation (NAV) Mode Tracking a VOR

Select the VOR frequency on the navigation receiver. Set course pointer to desired radial and direction to/from the station on the compass card. From any active condition shown in Table 3-3, the corresponding action engages navigation mode. NAV appears.

Table 3-3: Navigation (NAV) Mode

<table>
<thead>
<tr>
<th>Active Condition</th>
<th>Action</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roll mode engaged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>APR mode engaged</td>
<td>NAV pressed</td>
<td>NAV mode engaged</td>
</tr>
<tr>
<td>REV mode engaged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HDG mode engaged, NAV mode armed</td>
<td>Course captured</td>
<td></td>
</tr>
<tr>
<td>NAV GPSS engaged</td>
<td>VOR or LOC selected</td>
<td></td>
</tr>
</tbody>
</table>

The AP establishes the A/C on a 45° intercept angle relative to the selected course, with the exception of a pilot selectable intercept angle (§ 3.1.3.1). The course is captured upon reaching the point where the AP must begin to turn the A/C onto the course. After completing the turn, the AP establishes the crosswind correction angle and tracks the course.
Section 3 In-Flight Procedures

If a reference signal required for NAV fails, NAV mode transitions to FAIL, and **NAV** and **FAIL** alternately flash until the signal is valid once more. If this occurs prior to course capture, the AP holds the aircraft’s wings level and does not attempt to capture the course. However, if this occurs after course capture, it holds the last known crosswind corrected course and ignores CDI needle deflection.

Once tracking, if CDI needle deflection exceeds 50% from center for a period of 15 seconds, **NAV** flashes. If the A/C subsequently returns to within 50% CDI needle deflection from center, **NAV** stops flashing but remains.

At point of station passage, the AP recognizes the condition and holds the last known course. Either allow the A/C to pass over the station and pick it up again on the other side or select another VOR to track.

While either NAV or APR mode may be used to track a VOR, NAV mode is recommended. Do not press **APR** until cleared for approach and ready to arm to some vertical guidance.

### 3.1.3.1. Pilot Selectable Intercept Angle

To select an intercept angle other than 45°, set the heading bug to desired intercept heading on the compass card, so the difference between this heading and the desired course is the intercept angle. Set course pointer to desired course. Engage HDG mode, and press **NAV** to arm NAV mode. **HDG** and **NAV** appear.

---

**Figure 3-3: Navigation (NAV) Mode**

**Figure 3-4: Heading Mode Engaged, Navigation Mode Armed**
The AP establishes the A/C on the selected intercept angle (heading) and holds this heading until the course is captured. At that point in the intercept sequence, NAV replaces HDG indicating engagement of NAV mode.

### 3.1.4. GPS Steering (GPSS) Mode

Program a valid waypoint or flight plan into the GPS navigator and press NAV. NAV GPSS appears. The AP laterally steers the A/C along the predefined course. During GPSS mode of operation, the AP does not accept any course error input from the course pointer.

![Figure 3-5: NAV GPSS](image)

While either NAV or APR mode may be used for GPS/FMS steering, NAV mode is recommended. It is recommended to not press APR until cleared for the approach and ready to arm GS or GPSV for vertical guidance. Press APR to arm the AP to automatically transition to the FMS approach segment once reached. APR GPSL replaces APR GPSS once the FMS approach segment is reached.

![Figure 3-6: APR GPSS](image)

### 3.1.5. Control Wheel Steering (CWS) Mode

Press and hold the CWS switch to engage control wheel steering mode. CWS appears, while an audible alert sounds. In addition, both the roll and pitch servos disengage. Maneuver the A/C as desired, and then release the CWS switch to disengage CWS mode. CWS extinguishes, and both servos re-engage.
Figure 3-7: Control Wheel Steering (CWS) Mode

The AP resumes operation in the previous mode. If HDG, NAV, GPSS, APR, or REV mode was engaged, the AP returns to tracking the selected. If IAS, VS, or ALT mode was engaged, the AP holds the new IAS, VS, or altitude, respectively. If roll or pitch mode was engaged, the AP holds the new roll attitude or pitch attitude, respectively.

3.1.6. Pitch Attitude (PITCH) Mode

From any active condition shown in Table 3-4, the corresponding action engages pitch attitude mode. PITCH appears. The AP holds the A/C at its current (captured) pitch attitude. Press UP to increase or DN to decrease captured pitch attitude. A single press changes the pitch attitude 0.25°.

<table>
<thead>
<tr>
<th>Active Condition</th>
<th>Action</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP READY</td>
<td>AP pressed</td>
<td>Pitch mode engaged</td>
</tr>
<tr>
<td></td>
<td>FD pressed</td>
<td></td>
</tr>
<tr>
<td>IAS mode engaged</td>
<td>IAS pressed</td>
<td></td>
</tr>
<tr>
<td>ALT HOLD mode engaged</td>
<td>ALT pressed</td>
<td></td>
</tr>
<tr>
<td>GS mode engaged</td>
<td>GA button pressed</td>
<td></td>
</tr>
</tbody>
</table>

Table 3-4: Pitch Attitude (PITCH) Mode

Figure 3-8: Pitch Attitude (PITCH) Mode
3.1.7. Indicated Airspeed (IAS) Mode

From any active condition in Table 3-5, the corresponding action engages indicated airspeed mode. **IAS** appears with the current (captured) IAS in units of kts (for example, 105). The AP holds the A/C at the captured IAS. Press **UP** or **DN** to increase or decrease the captured IAS. Press once to change the IAS by 1 KT, or press and hold to change at a rate of 5 kts per second.

**Table 3-5: Indicated Airspeed (IAS) Mode**

<table>
<thead>
<tr>
<th>Active Condition</th>
<th>Action</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitch mode engaged</td>
<td></td>
<td>IAS pressed</td>
</tr>
<tr>
<td>VS mode engaged</td>
<td></td>
<td>IAS mode engaged</td>
</tr>
<tr>
<td>ALT CAP mode engaged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALT HOLD mode engaged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS mode engaged</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 3-9: Indicated Airspeed (IAS) Mode**

**CAUTION:**

Engine power and airspeed must be monitored when IAS mode is engaged, since insufficient power at low airspeeds may cause the A/C to stall and the AP to disconnect. Although the AP should limit the airspeed to 3-5 knots (kts) below the aircraft’s maximum operating airspeed $V_{MO}$, large power changes at higher airspeeds may cause the A/C to momentarily exceed $V_{MO}$.

3.1.8. Vertical Speed (VS) Mode

From any active condition shown in Table 3-6, the corresponding action engages vertical speed mode. **VS** appears with the current (captured) VS in units of fpm prefixed by either $\uparrow$ (up arrow) indicating climb, or $\downarrow$ (down arrow) indicating descent (for example, $\uparrow$500 indicates 500 fpm climbing). The AP holds the A/C at the captured VS.
Table 3-6: Vertical Speed (VS) Mode

<table>
<thead>
<tr>
<th>Active Condition</th>
<th>Action</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitch mode engaged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IAS mode engaged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALT CAP mode engaged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALT HOLD mode engaged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS mode engaged</td>
<td>VS pressed</td>
<td>VS mode engaged</td>
</tr>
</tbody>
</table>

Figure 3-10: Vertical Speed (VS) Mode

Press **UP** or **DN** to increase or decrease the captured VS. A single press changes the VS by 100 fpm.

During a climb, if the commanded VS exceeds the actual VS by 300 fpm for a period of 10 seconds, **VS** flashes as an alert to the potential for an impending stall condition. In this event, immediately increase the aircraft’s thrust if possible, reduce the commanded VS using **DN**, or both, until **VS** stops flashing.

3.1.9. Altitude Hold (ALT HOLD) Mode

From any active condition shown in Table 3-7, the corresponding action engages altitude hold mode. **ALT HOLD** appears.

For analog installations that do not provide BARO-corrected altitude, the altitude target is not selectable. In this case, any target selected by scrolling either concentric SELECT knob is replaced with dashes, **----**, and altitude preselect is not available.

For all other configurations, scrolling either concentric SELECT knob a single detent causes the current (captured) baro-corrected altitude to also appear in units of feet (ft.) (for example, **12500**). The AP holds the A/C at the captured altitude.
Modifying the altitude target does not change ALT HOLD mode. The AP holds the A/C at the captured altitude. Press **UP** or **DN** to increase or decrease captured altitude. A single press changes the altitude by 20 ft., and the range is ±500 ft. from the original captured altitude.

### Table 3-7: Altitude Hold (ALT HOLD) Mode

<table>
<thead>
<tr>
<th>Active Condition</th>
<th>Action</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitch mode engaged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IAS mode engaged</td>
<td>ALT pressed</td>
<td>ALT HOLD mode engaged</td>
</tr>
<tr>
<td>VS mode engaged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALT CAP mode engaged</td>
<td>ALT pressed</td>
<td>Target altitude captured</td>
</tr>
<tr>
<td>GS mode engaged</td>
<td>ALT pressed</td>
<td>APR LOC mode disengaged</td>
</tr>
</tbody>
</table>

![Figure 3-11: Altitude Hold (ALT HOLD) Mode](image)

3.1.10. Altitude Pre-Select Function

The altitude pre-select function is not applicable to analog installations that do not provide BARO-corrected altitude.

The altitude pre-select function allows for pre-selection of a target altitude and the speed (if within the aircraft’s capabilities) or pitch angle at which the A/C climbs or descends until the altitude is captured. Pre-select the target altitude using the SELECT knob. Rotate either knob CW to increase or CCW to decrease the target altitude. The outer knob changes the target altitude in increments of 1000 ft., whereas the inner knob changes in increments of 100 ft. Target altitude appears in units of ft. (for example, **12500**) with **ALT** to indicate ALT HOLD mode is armed.
If the AP is not receiving altitude targets from an external EFIS source, press the inner knob once to cancel the target altitude and display dashes instead. Press it again to restore the target altitude. If no target altitude is initially selected, indicated by dashes, then rotate either knob a single detent to cause the current altitude to appear. A pre-selected altitude may be captured from VS, IAS, or PITCH (ALT armed). If the connected EFIS is providing altitude targets, pressing the inner knob cannot disarm nor cancel the current target altitude, so the current target remains displayed on the AP. The target can still be altered using the AP inner and outer knobs, or adjusting the altitude target bug on the connected EFIS.

1) Engage VS mode. Press **UP** to set rate of climb or **DN** to set rate of descent. **VS** replaces the prior pitch axis mode annunciation, and the selected VS appears in units of fpm (for example, ↑500 indicates 500 fpm climbing); OR

2) Engage IAS mode. Press **UP** or **DN** to select desired IAS and adjust power to climb or descent. **IAS** replaces the prior pitch axis mode annunciation, and the selected airspeed appears in units of kts; OR

3) Engage pitch hold mode by pressing **ALT**. Use CWS to establish desired angle of climb or descent.

When the A/C arrives 1000 ft. from the target altitude, an audible alert sounds followed by the audible alert, “One Thousand to Go.” Once the point has been reached at which the AP must begin a scheduled reduction in VS, the target altitude is captured. **CAP** replaces the active annunciation.
indicating engagement of ALT HOLD CAP mode. At 200 ft. from altitude, the audible alert sounds again, followed by the audible alert, “Two Hundred to Go.”

![Figure 3-14: ALT HOLD CAP Mode](image)

When the A/C reaches the target altitude, the audible alert, “Altitude,” sounds, and ALT HOLD mode engages. ALT extinguishes, and ALT HOLD replaces CAP (Figure 3-11). If the A/C happens to subsequently exceed a distance of ±200 ft. from the captured altitude, the audible alert, “Check Altitude,” sounds.

3.1.11. Automatic Trim Annunciations

When the trim master switch is in ON position, the AP indicates when it is automatically trimming the A/C. If the servo loading exceeds a preset threshold for a period of 3 seconds, the AP indicates out-of-trim (TRIM ↑) as the AP is automatically trimming the A/C. If the AP is still automatically trimming the A/C after 8 more seconds, the trim annunciation flashes, and the audible alert, “Trim in Motion,” sounds repeatedly. As soon as the A/C has been sufficiently trimmed, so the servo loading is below the preset threshold, the trim annunciation extinguishes and the audible alert ceases.

![Figure 3-15: Pitch Trim Annunciations - UP](image)

![Figure 3-16: Pitch Trim Annunciations - DOWN](image)
3.1.12. Manual Trim Annunciations

When the trim master switch is OFF, the AP indicates when it is necessary to trim the A/C. If servo loading exceeds a preset threshold for a period of 3 seconds, the AP indicates out-of-trim (TRIM ↑). In addition, the audible alert “Check Pitch Trim” sounds once. After 8 more seconds, the trim annunciation flashes. As soon as the A/C has been sufficiently trimmed the trim annunciation extinguishes.


The manual electric trim switch, located on the control wheel/stick, can only be used to trim the A/C when AP mode is disengaged. Attempting to use it otherwise disconnects the AP. To trim the A/C nose up, press aft and maintain pressure on both segments of the manual electric trim switch. To trim the A/C nose down, press forward and maintain pressure on both segments of the manual electric trim switch. In either case, TRIM flashes.

3.2. Precision Approach Procedures

3.2.1. Straight-In ILS Approach

Execute a straight-in intercept and track the front inbound LOC course with either PITCH, IAS, VS, or ALT HOLD engaged. From any active condition shown in Table 3-8, the corresponding action arms GS mode, and GS appears. To disarm GS mode, engage a different roll mode.

<table>
<thead>
<tr>
<th>Active Condition</th>
<th>Action</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>APR mode</td>
<td>APR LOC mode engaged&lt;br&gt;CDI &lt; 50%&lt;br&gt;GDI &lt; 50% above GS</td>
<td>GS mode engaged</td>
</tr>
</tbody>
</table>
With GS mode armed, once the A/C arrives within 25% of the GS centerline, either above or below, the glideslope is captured. CAP, indicating GS CAP mode engagement, replaces the active pitch mode annunciation, and a VS proportional to the IAS is established.

With GS CAP mode engaged, once the A/C arrives within 5% of the GS centerline, either above or below, or a period of 10 seconds has elapsed, GS mode engages. GS replaces CAP marking the end of the intercept sequence and beginning of tracking.

Once tracking, if GDI needle deflection exceeds 50% from center, GS flashes. If one or more of the reference signals required for GS fail, GS and FAIL alternately flash. At the decision height (DH) or missed approach point (MAP), disconnect the AP to execute either a manual landing or go-around, respectively.
3.2.2. ILS Approach with Procedure Turn

Execute a procedure turn intercept and track the front inbound LOC course above the approach altitude, just until the A/C is established on the front inbound procedure turn heading, with HDG mode still engaged. Press \textit{VS} to engage VS mode and use \textit{DN} to select desired descent speed. Upon reaching the approach altitude, press \textit{ALT} to engage ALT HOLD mode. Press \textit{APR} to arm APR LOC mode, so the AP executes a straight-in intercept and track of the front inbound LOC course.

Execute a straight-in intercept and track the GS. For A/C equipped with GPS navigators providing roll steering output data with GPSS mode engaged, the AP is capable of executing the entire lateral approach sequence if it has been programmed into the GPS navigator. Once on the front inbound LOC course, with GPS navigator set to VLOC and GS mode armed, press \textit{APR} to engage APR LOC mode and complete the ILS approach.

3.3. Non-Precision Approach Procedures

3.3.1. Straight-In Back Course Approach

From any active condition shown in Table 3-9, the corresponding action engages REV mode. \textbf{REV} appears.

\begin{table}[h]
\centering
\begin{tabular}{|l|l|l|}
\hline
\textbf{Active Condition} & \textbf{Action} & \textbf{Result} \\
\hline
Roll mode engaged & \textbf{APR} pressed while on a localizer BC & \\
NAV mode engaged & & \\
HDG mode engaged & \textbf{APR} pressed to arm REV mode. Localizer BC captured and BC logic identified by AP & REV mode engaged \\
APR mode engaged & Localizer BC captured and BC logic identified by AP & \\
APR LOC mode engaged & & \\
\hline
\end{tabular}
\end{table}
1) Select LOC frequency.

2) Set course pointer to front inbound LOC course.

3) Press APR. REV mode automatically engages if course pointer is set to inbound course and BC logic is identified by the AP. A/C intercepts the inbound selected course at a 45° angle; OR

Set heading bug to desired intercept heading, press HDG to engage HDG mode. Press APR (BC logic automatically identified by the AP) to arm REV mode.

4) AP intercepts and tracks the back inbound LOC course.

3.3.2. Straight-In LOC Approach

From any active condition shown in Table 3-10, the corresponding action engages APR LOC mode. APR LOC appears.

<table>
<thead>
<tr>
<th>Active Condition</th>
<th>Action</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roll mode engaged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NAV mode engaged</td>
<td>APR pressed</td>
<td>APR LOC mode engaged</td>
</tr>
<tr>
<td>HDG mode engaged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HDG mode engaged, APR LOC mode armed</td>
<td>LOC back course captured</td>
<td></td>
</tr>
</tbody>
</table>
3.3.3. LOC Approach with Procedure Turn

3.3.3.1. Automatic Method

1) Load and activate the localizer approach with procedure turn.

2) CDI selected to GPS.

3) Press **NAV** to engage NAV GPSS.
4) AP follows roll steering commands from FMS and flies procedure turn.

5) Once inbound, press \textbf{APR} to enable GPSL mode.

### 3.3.3.2. Manual Method

From any active condition shown in Table 3-11, the corresponding action engages REV mode. \textbf{REV} appears (Figure 3-22).

<table>
<thead>
<tr>
<th>Active Condition</th>
<th>Action</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roll mode engaged</td>
<td>REV button (if configured) pressed or \textbf{APR} pressed with BC logic identified by AP</td>
<td>REV mode engaged</td>
</tr>
<tr>
<td>HDG mode engaged, REV mode armed</td>
<td>Front outbound LOC course captured and BC logic identified by AP</td>
<td></td>
</tr>
<tr>
<td>APR mode engaged</td>
<td>REV button (if configured) pressed or BC logic identified by AP</td>
<td></td>
</tr>
<tr>
<td>APR LOC mode engaged</td>
<td>REV button (if configured) pressed or BC logic identified by AP</td>
<td></td>
</tr>
</tbody>
</table>

![Figure 3-26: LOC Approach with Procedure Turn](image)

1) a) Select LOC frequency.

   b) Set course pointer to front outbound LOC course.

   c) Press \textbf{APR} (BC logic has been identified) to engage BC mode (or press BC button, if configured) and intercept the inbound selected course at a 45° angle; OR

   Set heading bug to desired intercept heading, press \textbf{HDG} to engage HDG mode, and then press \textbf{APR} (BC logic has been identified) to arm BC mode.
d) AP intercepts and tracks the front outbound LOC course.

2) a) At appropriate time, set heading bug to front outbound procedure turn heading. Hold heading until it is time to turn the A/C again.

b) Press **HDG** to engage HDG mode. HDG appears.

![Figure 3-27: HDG Mode](image)

3) a) Turn heading bug in two successive 90° increments, to establish A/C on front inbound procedure turn heading.

4) a) Press **APR** to arm APR LOC mode. APR LOC appears below HDG. Once front inbound LOC course is captured, APR LOC replaces HDG (Figure 3-24).

![Figure 3-28: APR LOC Mode Armed](image)

b) AP intercepts and tracks front inbound LOC course.

c) At middle marker, if missed approach is declared, disengage AP by pressing either GA button or AP disconnect button.

d) Stabilize A/C.

e) Set heading bug to missed approach heading.

f) Press **HDG** to engage HDG mode.

For A/C equipped with GPS navigators providing roll steering output data, with GPSS mode engaged, the AP is capable of executing this entire lateral approach sequence, if it has been programmed into the GPS navigator. Once on front inbound LOC course, with the GPS navigator set to VLOC, press **APR** to engage APR LOC mode and complete the intercept.
3.3.4. GPS Steering (GPSS) RNAV Approach

1) a) Program approach into GPS navigator.
   b) Press \text{APR} to engage FMS mode. \text{APR GPSS} appears.
   c) AP laterally steers the A/C along predefined approach, toward the IAF and FAF, making required turn between them.
   d) Begin descent at IAF in VS or IAS mode.

2) a) Prepare for turn toward FAF.

3) a) At MAP, if missed approach is declared, disengage AP by pressing either GA button or AP disconnect button.
   b) Stabilize A/C.
   c) Set heading bug to missed approach heading.
   d) Press \text{HDG} to engage HDG mode.

During GPSS mode, the AP does not accept any course error input from the course pointer.
For A/C equipped with the WAAS capable GPS navigator, the AP can execute the entire lateral and vertical approach sequence.

With either PITCH, IAS, VS, or ALT HOLD engaged, select the appropriate WAAS approach on the GPS navigator from the following possibilities:

1) LPV
2) LNAV/VNAV
3) LNAV+V

Once the following conditions are met, GS mode is armed:

1) CDI < 50%
2) GDI < 50% above glidepath

**APR GPSL** and **GPSV** appear.

![Figure 3-31: GPSL and ALT HOLD Modes Engaged](image1)

With GPSV mode armed, once the A/C arrives within 25% of glidepath centerline, either above or below, glidepath is captured. **CAP**, indicating engagement of GPSV CAP mode, replaces the active pitch mode annunciation, and a VS proportional to the IAS is established.

![Figure 3-32: GPSV CAP Mode Engaged](image2)

With GPSV CAP mode engaged, once the A/C arrives within 5% of glidepath centerline, either above or below, or a period of 10 seconds has elapsed, GPSV mode engages. **GPSV** replaces **CAP** marking the end of intercept sequence and beginning of tracking. At DH or MAP, disconnect AP to execute a manual landing or go-around, respectively.
3.4. Level (LVL) Mode

**NOTE:**

Level (LVL) mode functionality may differ from airframe to airframe. Reference the specific aircraft models AFMS for LVL mode functionality and operation.

Press LVL to engage LVL mode. In addition, the level discrete is an optional switch in the cockpit to place the AP in an attitude recovery mode. To disengage this mode, press LVL again.

Engagement is indicated by the modes on the AP display changing to ROLL/PITCH and the flight director setting to wing-level and the configured pitch angle for the aircraft (refer to AFMS for pitch angle value). LVL mode can be engaged or disengaged at any time, regardless of the roll axis or pitch axis mode.

### 3.4.1. Emergency Level Mode

Emergency level mode is designed to bring the A/C to wing-level recovery, when the AP is disengaged and in standby mode (AP READY).

Press LVL or the level discrete switch to engage LVL mode. The AP servos automatically engage to bring the A/C to wings-level and the configured pitch angle for the aircraft (refer to AFMS for pitch angle value). The AP LED does not illuminate, but an audible alert, “Level Mode, Engage Autopilot,”
repeats. To resume normal AP functionality and cancel the audible alert, the AP must be manually engaged by pressing AP. The AP LED illuminates.

![Figure 3-35: LVL Mode; Servos Engaged, No AP](image)

### 3.5. Yaw Damper (YD) Mode

**NOTE:**

Not applicable to aircraft without optional yaw damper installed.

![Figure 3-36: Without Optional Yaw Damper Installed](image)

With AP READY displayed, press YD to engage yaw damper mode. To disengage this mode, press YD. The YD LED is illuminated when engaged (Figure 3-37) but extinguished when disengaged (Figure 3-38). YD mode can be engaged or disengaged at any time, regardless of roll or pitch mode. When YD mode is engaged, the yaw damper dampens any excessive adverse yaw and coordinates turns.

![Figure 3-37: YD Mode Engaged](image)
CAUTION:

YD mode should always be disengaged prior to takeoff and landing.

3.6. Half Bank (HB) Mode

The half bank (HB) mode is an optional switch/annunciator in the cockpit that limits the AP authority and improves passenger comfort. From HDG or GPSS mode, press the HB switch to engage HB mode. When HB is engaged, the AP limits the commanded bank angle and maximum command bank angle by 50%.

“ON” illuminates when half bank is engaged. “OFF” illuminates when half bank is disengaged.

Figure 3-39: Half Bank (HB) Mode Switch/Annunciator

HB mode disengages either by pressing the switch again or if the autopilot mode is not HDG or GPSS mode.

NOTE:

HB mode ONLY operates in HDG mode or GPSS mode.

3.7. Flight Director (FD) Operation

The flight director (FD) is a display of the flight profile comprised of a pair of command bars and an A/C symbol superimposed upon a pitch ladder. It is commanded by the AP. The FD operates either with both the AP and FD modes engaged, or with AP mode disengaged and FD mode engaged.
3.7.1. AP and FD Modes Engaged

With AP READY displayed, press \textbf{AP} to engage AP and FD modes. Illuminated AP and FD LEDs indicate engagement of these modes, and FD bars depicted. The AP steers the A/C toward the steering command bars, until the A/C symbol is tucked into them, for any roll axis or pitch axis mode of operation. The FD provides a visual indication of how accurately the AP is tracking its own roll and pitch commands.

![Figure 3-40: AP and FD Modes Engaged](image)

3.7.2. FD Mode Engaged and AP Mode Disengaged

With AP READY displayed, press \textbf{FD} to engage FD mode, as indicated by an illuminated FD LED. Alternately, with AP READY displayed, press \textbf{AP} to engage AP and FD modes. Press it again to disengage AP mode, thereby disengaging both the roll and pitch servos. With FD mode engaged and AP mode disengaged, the pilot must steer the A/C toward the command bars, until the A/C symbol is tucked into them, for any roll axis or pitch axis mode of operation. The FD provides a visual indication of how accurately the pilot is tracking roll and pitch commands from the AP.

![Figure 3-41: FD Mode Engaged, AP Mode Disengaged](image)

3.8. Go-Around (GA) Button

Press the GA button for the following simultaneous events:

1) Disengage AP mode
2) Engage FD mode
3) Engage roll mode, holding roll attitude of wings level
4) Engage pitch mode, holding pitch attitude specific to A/C type
5) Cancellation of any armed roll mode
6) Cancellation of any armed pitch mode
7) Cancellation of any target altitude

Figure 3-42: Go-Around (GA)

3.9. Menu (MNU) Button

Press **MNU** to modify the display contrast and brightness and to mute selected audible alerts, as follows:

1) Rotate **(outer knob)** CW to increase or CCW to decrease display contrast.

2) Rotate **(inner knob)** CW to increase or CCW to decrease display and mode button brightness.

3) Push **(inner knob)** to toggle mute (indicated by icon). When muted, all aural alerts are muted except for the disconnect tone. When unmuted, all configured (loaded) aural alerts and tones sound.

Figure 3-43: Mute Icons
4) Press **UP** to increase brightness of AP, FD, and YD LEDs.

5) Press **DN** to decrease brightness of AP, FD, and YD LEDs.

Menu activity does not affect the engaged AP modes. If the AP does not detect any menu activity for a period of 5 seconds, it reverts to the previous display. All menu settings are retained through subsequent power cycles, except for muted audible alerts.

### 3.10. Automatic Trim Disable

Disconnect the automatic trim function by any of the following:

1) Press/Hold remote AP DISC/TRIM INTR switch.

2) Set trim master switch to OFF position.

### 3.11. Autopilot Disconnect

The AP can be disconnected by any of the following means:

1) Press remote AP DISC/TRIM INTR switch.

2) Set AP master switch to OFF position.

3) Pull AP circuit breaker.

4) Press **AP** when AP mode is engaged, but FD mode is disengaged.

5) Press **FD** when FD mode is engaged, but AP mode is disengaged.

### 3.12. Maintenance Mode

When the maintenance discrete is asserted during power up, the AP enters a diagnostic mode. This mode allows for more diagnostics messages to be transmitted from the AP, a flight test tool to inject failures using controller area network (CAN) messages, and a variety of monitors to be disabled. This mode is primarily intended to be used during initial flight testing and tuning for the A/C type by a Genesys Aerosystems flight test engineer.
4.1. Pre-Flight Checks

1) Press/Hold **UP**. Airspeed indication increases on AP. If interfacing EFIS has the ability, increase IAS target on EFIS. IAS target speed flashes off, then back on with speed selected from EFIS.

2) Press/Hold **DN**. Airspeed indication decreases on AP display. If interfacing EFIS has the ability, decrease IAS target on EFIS. IAS target speed flashes off, then back on with speed selected from EFIS.

3) Press **VS** to engage VS mode. VS replaces IAS on AP. Number indicates current VS in fpm.

4) Press/Hold **UP** until a commanded VS of **500** (500 fpm climbing) is reached. A/C control moves aft – pilot may have to assist a heavy yoke. If interfacing EFIS has the ability, increase VS target on EFIS. VS target speed flashes off, then back on with the VS selected from EFIS.

5) Press/Hold **DN** until a commanded VS of **500** (500 fpm descending) is reached. A/C control moves forward. If interfacing EFIS has the ability, decrease VS target on EFIS. VS target speed flashes off, then back on with the VS selected from EFIS.

4.2. Indicated Airspeed (IAS) Mode

Press **UP** to increase or **DN** to decrease the captured IAS. A single press changes the IAS by 1 kt, or press and hold to change at a rate of 20 kts-per second. If the interfacing EFIS is capable of transmitting a selected IAS, the captured IAS may also be increased or decreased on the EFIS (§ 3.1.7).

4.3. Vertical Speed (VS) Mode

During a climb, if the commanded VS exceeds the actual VS by 300 fpm for a period of 10 seconds, VS flashes as an alert to the potential for an impending stall condition. In this event, immediately increase the aircraft’s thrust if possible, reduce the commanded VS using **DN**, or both, until VS stops flashing. If interfacing EFIS is capable of transmitting a selected IAS, captured VS may also be increased or decreased on the EFIS (§ 3.1.8).
4.4. Altitude Hold (ALT HOLD) Mode

Modifying the altitude target does not change ALT HOLD mode. The AP holds the A/C at the captured altitude. Modifying the altitude target on the EFIS sets up the next pre-select altitude target to be captured from PITCH, VS, or IAS with ALT armed (§ 3.1.9).

If the interfacing EFIS is capable of transmitting a selected altitude, the pre-selected altitude may also be increased or decreased on the EFIS. Following an altitude target change on the EFIS, the target altitude displayed on the AP dashes. If it is desired to display the updated selected altitude on the AP again, press the inner SELECT knob once. The current select altitude is updated by the last input from either the SELECT knob on the AP itself or from the interfacing EFIS. A change on either overwrites the previous.
Section 5 Emergency Procedures

5.1. Automatic Trim Disable

Disable automatic trim function by any of the following means:

1) Press/Hold remote AP DISC/TRIM INTR switch.
2) Set trim master switch to OFF position.
Section 6 Operating Parameters

6.1. Roll Axis Limits

Roll Attitude: Greater 38° and not recovering (AP disconnects)
Roll Rate: 10°/sec (AP disconnects)

6.2. Pitch Axis Limits

Pitch Attitude: 22° and not recovering (AP disconnects)
Pitch Rate: 4°/sec (AP disconnects)

Vertical Force Due to Acceleration: ±0.6 g disregarding 1g due to gravity (AP disconnects)
## Section 7 Glossary

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S-TEC 3100 Digital Autopilot
Digital and Analog